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Replicable Measures from Sustainable Energy Action Plans (SEAPs) of Ukraine

Examples of the Measures for Sustainable Urban Demonstration Projects

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Pictures of buildings from "The European GreenBuilding Projects Catalogue July 2011- August 2012", Report EUR 25773 EN and from "The European GreenBuilding Projects Catalogue — September 2012– December 2013"

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Abstract

This document described examples of measures that could be used for Sustainable Urban Demonstration projects (SUDeP) in the Eastern Partnership cities. The examples of measures with high degree of replicability are selected from the Sustainable Energy Action Plan (SEAPs) of Ukraine. The measures are focused on achieving energy savings and improving energy efficiency in the sectors where local authorities have the control and influence. In addition, measures on renewable energy are considered along with measures on information systems to monitor and control energy consumption

INTRODUCTION

This document is aimed to present to local authorities examples of the measures that could be used for Sustainable Urban Demonstration projects (SUDeP)[1] in the Eastern Partnership cities (Ukraine, Moldova, Belarus, Georgia, Armenia, and Azerbaijan). The examples of the measures that have high degree of replicability are selected from the Sustainable Energy Action Plan (SEAPs) developed under the of Covenant of Mayors initiative[2]. The measures are focused on achieving energy savings and improving energy efficiency in the sectors where local authorities have the most control and influence. In addition, measures on renewable energy are considered along with measures on information systems to monitor and control energy consumption.

In this document measures are presented based on information described in SEAPs submitted by local authorities of Ukraine. It aims to provide a short description of typical measures, while the detailed technical description is provided in the guidebook "How to develop the Sustainable Energy Action Plan (SEAP) in the Eastern Partnership and Central Asian Cities"[3].

CONTENT

[1] More information can be found at: https://webgate.ec.europa.eu/europeaid/online-services/index.cfm?do=publi.welcome&nbPubliList=15&orderby=upd&orderbyad=Desc&searchtype=RS&aofr=135376

[2] More information can be found at: http://www.soglasheniemerov.eu/index_ru.html

[3] The Guidebook can be found at: http://www.soglasheniemerov.eu/support/library_ru.html

1. PUBLIC AND RESIDENTIAL BUILDINGS: ENERGY SAVING MEASURES

The most typical measures in residential and public buildings are focused on r**efurbishment** of old buildings in order to reduce their heating demands. The measures are grouped according to the area of intervention:

1. **Providing energy audits services** for institutional buildings, which a technical study of potential energy savings in buildings and a first step before taking the final decision on measures that will be implemented to increase the energy efficiency. It analyses the characteristics of the building construction and equipment, as well as the energy consumption and performance data, which are collected by means of surveys, measurements or energy consumption bills provided by utilities and operators.

   - ***Providing consulting services energy saving measures for citizens*** via phone and internet and establishing free phone number for such services. Advice on simple and cost effective measures (including behavioral-change measures) is provided to citizens so they can implement such measures themselves and gain immediate benefits of reduced energy consumption

   - ***Providing energy passport for residential buildings*.** Residential buildings are evaluated from energy efficiency viewpoint and grouped according energy consumption per m^2. An official document is produced specifying type of building according to energy consumption classification.

2. Typical measures for the **improvement of the building envelope**:

   - ***Refurbishment of external facades and walls*** in municipal educational and health care buildings (kindergartens, schools, hospitals and clinics). Thermal performance of the walls is improved by placing an additional slab or cover of insulating material, insulation is also used to fill cavity walls. Thermal bridges (e.g. junctions between walls and windows or doors) are also considered when insulating buildings as they can significantly increase heat losses and heating demands. – ***Refurbishment of external walls and roofs in residential buildings.***

   - ***Replacement of windows and entrance doors*** in municipal educational and health care buildings. The typical solution replacing old wooden frame window to windows of metal-plastic frames. Old wooden doors that no longer fit well in its jamb and do not close tightly (increasing heat losses in the winter) and are replaced by hermetic metal-plastic frame doors. Such solutions reduce more than 30% of energy consumption per m2 of glazed surface. The other less popular solution is use of windows with Low-Emissivity Argon filled double glazing up to 1,1 W/(m2·K), and up to 0,7 W/(m2·K) for triple glazing. – Replacement ***of windows and doors in residential buildings.***

3. Typical measures for ***heat substations*** in individual buildings:

   - ***Installation of individual heat substations*** in residential buildings (typically in existing old heating system such heat substations

were designed for a group of buildings thus lowering the consumption control and regulation possibilities). Installation of such substations ensures proper regulation and control of heat supplied to individual building from a central heating system. Heat substations consisting of heat meter, temperature controller and temperature sensors ensure proper supply, control and metering of hot water and supplied heat. It also provides automatic regulation of supplied heat depending on the outdoor temperature.

- ***Renovation of existing heat substations and installing heat*** and metering control with automatic regulation of supplied heat depending on the outdoor temperature.

4. Renovation of a ***building heating system*** and tap water supply systems in municipal buildings.

    - ***Replacement of old radiators*** to new generation efficient radiators that have characteristics of higher heat transmission.

    - ***Replacement of pipe*** (leaking, corroded) in a heating system by new pipes, as it reduces the pressure losses throughout the system and requires less pumping energy.

    - ***Installing a HVAC system*** (heating, ventilation and air conditioning system) with heat recuperation in municipal buildings that are used education purposes. For heat recuperation, the exhaust air from a building is used to heat up incoming air that is supplied to ventilation system. For this a heat exchanger with additional van and air filters are installed.

    - ***Installation of warm air curtains*** (air barrier across an opening) in municipal administration building. It reduces heat losses through the entrance when entryways and doors are used continuously.

    - ***Installation of a radiator reflector*** (thin foil) behind a radiators in residential buildings to reduce heat losses into the wall, and thus to outside the building.

5. Installation of ***energy control and monitoring systems***:

    - ***Installation of thermostatic radiator valves*** in municipal educational and health care buildings as well as residential building. A thermostatic radiator valve - a self-regulating valve – is installed in the radiator supply pipeline, where it controls the temperature of a room by changing the flow of hot water to the radiator.

    - Installation of individual ***heat metering system*** in every apartment of a residential building. With such system, consumers know exactly how much they consume, and can control of energy consumption. In old heating systems, it is challenging because of a technical system design (not everywhere pipe branches are available for installing heat meters that could separate the system of one flat from another). In such cases, a heat metering devises is used to measure the heat consumption of the every radiator in an apartment. These devises had a remote heat reading of the heat consumption and can provide a total energy consumption of an apartment.

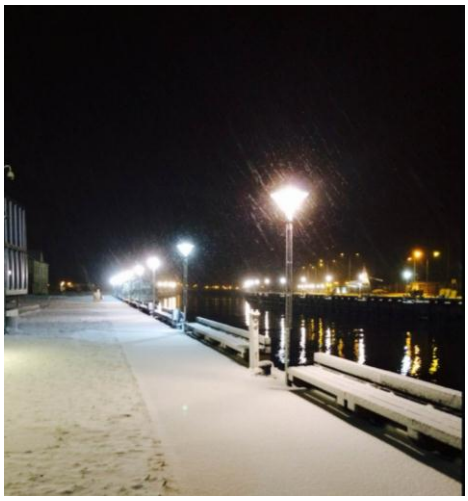
In addition, the following measures have high potential of replicability when considering energy savings in residential buildings:

- Installing new ***energy-efficient lifts*** powered by electric motors in residential buildings (higher than 5 floors) that have reduced consumption of electricity.

2. PUBLIC LIGHTING: ENERGY EFFICIENCY MEASURES

The most typical energy efficient measures in public lighting are focused on replacement of lighting systems to ***Light Emission Diode (LED)*** and ***compact fluorescent lamp (CFL)***:

- ***The replacement*** of incandescent halogen bulb lights in s***treet lighting*** by more energy-efficient and durable LED. When compared to incandescent bulbs, LED reduced energy consumption by 50% and reduce maintenance costs (because LED's lifespan is 100,000 hours, which makes 10 times more than incandescent bulbs) LED emitted light is brighter than the incandescent lights, making them more visible in adverse conditions
- Equipping ***traffic light signals*** for road traffic with LEDs replacing incandescent light bulbs.
- Powering ***traffic lights and signals*** by solar energy with a backup battery during the night.



- Replacement of an incandescent lamp to ***a compact fluorescent lamp in municipal educational and health care buildings***. This reduces significantly energy consumption for lighting and maintenance.
- ***Installing of LED in municipal hospitals*** in all the emergency lighting, which is on 24 hours a day.
- ***Introduction of regulation systems of public lighting***, such as occupancy and motion controls, time scheduling or luminaire optimisation. For this, lighting control devices are installed to regulate the operation of the lighting system in response to an external signal (manual contact, occupancy, clock, light level). Energy-efficient control systems include:
    - Localised manual switch
    - Occupancy linking control
    - Time scheduling control
    - Day lighting responsive control

3. MUNICIPAL UTILITIES: ENERGY EFFICIENCY

In the municipal utilities, the measures on reconstruction of **district heating systems and water supply systems** are mostly considered.

1. Reconstruction of district heating system includes modernization or replacement of heating production units and distribution system.

- **Financing energy audit** for a district heating system to analyze performance of heat production units, a heat supply network and buildings systems. As a result, a work plane is developed to establish ***optimal operational regimes*** in a district heating system.
- Modernization of ***district heating networks***: replacement of heating pipelines that have exceeded their operational life time. – Replacement of outdated pipelines to preinsulated pipes to reduce heat losses from a distribution network. – Replacement of outdated pipelines to polyurethane foam insulation.
- Upgrading ***heating substations in municipal educational and health care buildings***– Replacing outdated pumps and heat exchanges in heating substations. – Metering of consumption and implementation of modern telecontrol systems in substations. – Setting control regimes according to outside weather temperature.
- Upgrading ***heating production plants***:
    - Building of small boiler stations for heat supply to municipal educational and health care buildings.
    - Replacement of outdated boilers to more efficient new generation boilers fueled by natural gas (or diesel) that supply heat to municipal hospitals.

2. Water supply systems:

- Renovation ***water supply network***: – replacement of leaking and corroded pipelines to new pipelines, which reduce pressure losses and safe pumping power.
- Renovation and upgrade of ***pumping stations*** and regulation stations: – ***Installation of variable speed driven pumps*** and efficient pumps with frequency inverter to adjust motor speeds individually.
- Establishing ***optimal operational regimes*** in water supply system by designing and selecting of optimal pressure and flow rates levels.
- Installation of an ***automated control and monitoring system*** for optimal operation of a water supply system.

4. TRANSPORT : ENERGY SAVING MEASURES, "GREEN" TRANSPORT

The most typical measures in transport sector can be divided into three groups: 1) improving service of public transport, 2) encouraging cycling and walking and 3) reducing municipal fleet and private vehicles emissions.

1) The typical measures on **improving service of public transport** that reduce the number of private vehicles:

- ***Improvement and maintenance of the public transport infrastructure***, including bus shelters and improved facilities at a bus station. – Improvement of ***a tram system*** by installing control system, electric meters, processing and condition gear wheelset for tram cars – Introduction of a public transport system with ***buses of large passengers' capacity.***

- ***Optimization of public transport network*** to increase service reliability and time-competitiveness. – ***Extension of public transport routes*** to remote districts of a city. – ***Priority routes*** are introduced for public transport to reduce travel time, which is one of the factors most considered by users when choosing among the different means of transport.

- ***Information systems*** provide information services about the schedule, arrival times and give information about connections.

- ***Smart transport*****:** urban traffic control systems are a specialised form of traffic management that integrate and coordinate traffic signal control. The urban traffic control optimises overall traffic performance in accordance with the traffic management policies. It uses the signal settings to optimise parameters such as travel time or stops.

  The other measures that have a high potential of replicability for touristic places: ***tourist shuttle system*** is created with a fixed route and stops at a variety of popular tourist destinations. This eliminates vehicle trips and parking spaces at popular destinations and provides an easy transportation alternative for tourists.

2) The typical measures on **encouraging cycling and walking:**

- ***Planning the system for cycling infrastructure*** to ensure a hierarchy of routes that are safe, well lit, signposted and maintained all year round. They are designed to be integrated with green space and pedestrian zones, other roads and the buildings of urban areas.

- ***Developing infrastructure:*** - An integrated ***network of cycling paths*** connecting various districts of a city and separate from motorised traffic – Introduction of ***bicycles parking system***. – Establishing ***services for renting bicycles*** in cultural city centre and natural areas.

  In addition, the following measures have potential of replicability when encouraging cycling:

- ***Route guidance and information***: information such as number or colour of the cycling ways and distances in order to make them easy for cyclists to follow.

- ***Safety:*** standards for safe driving to avoid the mixture of bicycles and other heavy means of transport.

- ***Integration with different modes of transport:*** develop parking facilities at railway stations or tramway/bus stops. Rent bicycles at

public transport and railway stations.

- ***Preventing Bicycle theft:*** imposing electronic identification bicycles and realisation of a national police registration for stolen bicycles.

3) The typical measures on **reducing municipal and private vehicle fleet emissions**

- ***Replacement of outdated vehicles*** with new vehicles that have been produced recently and have higher standards related to engine combustion emissions.

- ***Change of municipal vehicle fleet to use of biofuels:*** biodiesel, bioethanol and biogas. Biodiesel and bioethanol is mixed in diesel and gasoline engines, respectively, whereas biogas is used in natural gas vehicles (NGVs).

- ***Change of municipal vehicle fleet to use*** liquefied petroleum gas (LPG).

- Introducing a ***system that will limit access*** of vehicles to the city zones: - banning transport in the cultural city centre on holidays - limiting access to city zones with restrictions for heavy and high-emitting cars in cultural city centre and natural areas; - limiting access for private transport in the cultural city centre.

5. SOLID WASTE MANAGEMENT, WASTEWATER TREATMENT: IMPROVING QUALITY OF SERVICES

The following examples have a potential to be replicated in municipalities in the field of waste management and wastewater treatment:

- Establishing a ***system for separate waste collection*** in a city –Introducing collecting tanks or containers in the city, where organic waste, plastic and glass waste can be collected separately and further recycled. – Introducing a door-to-door collection of waste in a city – Introducing regular transportation for emptying the containers.

- Construction a ***plant of recycling solid waste,*** and using incineration to convert municipal solid waste to energy by combustion. This energy was planned to be used in a district heating system.

- Production of ***biogas for cogeneration plant*** from decomposition of organic waste from sewage and residual waters**.** The biogas (after it has been cleaned from undesirable compounds) was used in Combined Heat and Power (CHP) system in the combustion gas engine connected with an electric power generator.

6. RENEWABLE ENERGY: BIOMASS AND SOLAR/WIND ENERGY

The most typical measures on renewable energy are focused on biomass boilers and application of solar energy and heat pumps in municipal buildings. The measures are grouped according to the type of renewable energy:

1. ***Biomass boilers*** are applied for individual heating systems and for installation in heat substations that supply heat to residential and municipal buildings. The biomass boilers burn such CO_2 neutral products as pellets and wood chips[4].

   • ***Installation of biomass boilers (wood waste and chips)*** as alternative fuel in a heating plant that supplies heat to residential and municipal buildings. Such system operates on a fully automatic mode and does not require a manual boiler feeding.

Wood chips (source: bioenergy net)

   • ***Installation of*** individual heating systems on ***biomass boiler (wood chips) in school buildings.*** A storage room is required for wood chips.

   • ***Replacement*** of the gas boilers ***by biomass boilers*** on wood chips and pellets for heating of residential buildings. Pellets are easier to transport than chips and they require less storage value compared to wood chips. Fossil fuel boilers are replaced by biomass boilers during a building refurbishment, while the heat distribution installation and radiators are the ones used with the previous installation.

   • ***Installation of biomass boilers in combined heat and power generation.*** For electicity production in power plants, biomass boiler is used with natual gas boilers.

2. Solar energy:

   • Installation of solar collectors to produce domestic hot water in educational municipal buildings and hospitals. Such installation complements an existing heating system (gas boilers) and helps to reduce gas consumption. Solar collectors are typically installed on the roof of existing buildings.

3. ***Heat pumps:***

   • ***Installation of heat pumps*** to complement existing heating system in educational municipal buildings (such as kindergartens and schools). Gas boilers are used for heating of premises, while heat pumps are only used to heat-up individual rooms in premises that are not used 24 for hour per day, for example sports halls, workshops etc. A heat pump with a ground heat sources is typically used because of better performance that other types of heat pumps for cold climate in Ukraine. In north of Ukraine due to cold climate, heat pumps are also required a backup system (electrical or fuel).

   • ***Installation of heat pumps for heating and cooling municipal buildings.*** In this application, reverse heat pumps are applied that are used for heating in the winter and for cooling in the summer.

   • ***Installation of*** the individual combined heating systems on ***wood chips and heat pumps*** for heating kindergartens' buildings.

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[4] However, this is the case only if biomass is produced in a sustainable manner. For more information please refer to the Guidebook at: http://www.soglasheniemerov.eu/support/library_ru.html

4. ***Installation of photovoltaic models*** on the buildigns beloging to a munical hospital. Solar cells in photovoltaic models convert solar radiation to electricity, which is used for lighting and operating medical equipment.

7. INFORMATION SYSTEMS TO MONITOR & CONTROL ENERGY CONSUMPTION, AIR QUALITY

There are many measures that can be applied in the sector of Information System (ITC). From the experience of EU cities the following measures have been collected as best practice measures [5]:

- Integrated modelling solution based on BIM (building information modelling)
- Smart metering for energy consumption and awareness
- Building management systems
- Wireless sensor networks for energy performance assessment software
- Standards-based energy performance assessment software
- Energy performance audit solutions
- Websites for collecting and disseminating energy-efficiency "good practices"
- Standards-based solutions for building life-cycle management
- Standards-based energy data exchange solutions

In relation to this, the measures that most typically can be found in Ukrainian SEAP are ***metering and control equipment of energy consumption*** in heat production and distribution units, as well as in heat substation of individual buildings. It includes the control of energy consumption depending on the outside temperature.

Application of Building Management System in municipal and residential buildings is a measure that have a high potential to be replicable. In most frequent applications in Ukraine it is a computer-based control system that connects the building's mechanical and electrical equipments such as heating, cooling, and ventilation. In the EU cities, it sometimes includes lighting, and some appliances, in addition to fire systems, and security systems. An advanced Building Management System also has the ability to control the building's energy production and storage systems (photovoltaic panels, combined heat and power generators, batteries, etc.) along with the possibility to retrieve information from the Internet, like weather forecasts.

It uses a combination of:

- Wired or wireless sensors (for occupancy, movement, light fluxes, internal solar radiations, windows and doors states, blinds, indoor/outdoor conditions such as temperature, humidity, CO2, air quality.);
- Actuators for heating, cooling, ventilation systems, (can also include blinds, doors and windows, lights, energy production equipments);
- Meters for water, air flow and for energy (heat, electricity, gas),
- Centralized or distributed/embedded intelligence software, for activity monitoring, timetables implementation, optimization algorithms and user interfaces (real-time data display, alarms, remote control features, etc.),
- A central communication network using proprietary or open-standards.

5 http://www.greendigitalcharter.eu/wp-content/uploads/2012/11/2010-ICT-Supported-Energy-Efficiency-in-Construction_.pdf

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